

**EPA Superfund  
Record of Decision:**

**ORONOGO-DUENWEG MINING BELT  
EPA ID: MOD980686281  
OU 04  
JASPER COUNTY, MO  
07/29/1998**

**RECORD OF DECISION  
DECLARATION**

**SITE NAME AND LOCATION**

Oronogo/Duenweg Mining Belt Site, Operable Unit 4  
Jasper County, Missouri

**STATEMENT OF BASIS AND PURPOSE**

The U.S. Environmental Protection Agency (EPA) has prepared this decision document to present the selected remedial action for ground water at the Oronogo/Duenweg Mining Belt Site located in Jasper County, Missouri. This decision was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and to the extent practicable, the National Contingency Plan (NCP). This decision is based on the Administrative Record for this Site. The Administrative Record file is located in the following information repositories:

- |    |  |    |  |
|----|--|----|--|
| 1. | Joplin Public Library<br>300 Main<br>Joplin, Missouri                | 3. | Carl Junction City Hall<br>105 North Main<br>Carl Junction, Missouri                 |
| 2. | Webb City Public Library<br>101 South Liberty<br>Webb City, Missouri | 4. | U. S. Environmental Protection Agency<br>726 Minnesota Avenue<br>Kansas City, Kansas |

The EPA has coordinated selection of this remedial action with the Missouri Department of Natural Resources (MDNR). The State of Missouri concurs on the selected remedy.

**ASSESSMENT OF THE SITE**

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

**DESCRIPTION OF THE SELECTED REMEDY**

This selected remedy deals with providing safe drinking water supplies to residents currently consuming ground water contaminated with metals. This cleanup action is one part of the EPA's overall efforts under Superfund to deal with environmental contamination resulting from historic mining and smelting operations in Jasper County. Ground water contaminated solely from other sources will not be addressed by this cleanup action. Cleanup activities of metals contaminated residential yards have already been implemented. In the future, additional cleanup actions for the Site will deal with surface mining and milling wastes. This phased approach to the cleanup is being used for this Site in order to clean up the contamination which poses the greatest health threat first. The EPA believes that the selected remedy will be consistent with future cleanups that will be done at the Site.

The major components of selected remedy are:

- Support to Public Water Supply District #3 in the Oronogo/Duenweg Designated Area (DA)
- Extension of existing public water lines in the Oronogo/Duenweg DA
- Extension of existing public water lines in the Irons Gates Extension DA
- Installation of point-of-use treatment units to homes not accessible to public water
- A maintenance program for the point-of-use treatment units
- A monitoring program for threatened homes and the point-of-use treatment units
- Institutional controls to regulate future uses of the contaminated shallow aquifer

## **STATUTORY DETERMINATIONS**

The selected remedy is protective of human health and the environment, complies with location- and action-specific federal and state requirements that are legally applicable or relevant and appropriate to the remedial action and is cost-effective. However, a waiver of certain chemical-specific applicable or relevant and appropriate requirements is justified because of the technical impracticability of achieving these requirements for this Site. This remedy utilizes permanent solutions to the maximum extent practicable. Other than five point-of-use treatment units, treatment of ground water was not found to be practical and this remedy does not satisfy the statutory preference for treatment as the principal element.

Because this remedy will result in hazardous substances remaining on the Site above health-based levels, a review will be conducted within five years to ensure that the remedy continues to provide adequate protection of human health and the environment.

<IMG SRC 98026A>

RECORD OF DECISION

GROUND WATER  
OPERABLE UNIT 04  
ORONOGO/DUENWEG MINING BELT SITE  
JASPER COUNTY, MISSOURI

Prepared by:

U. S. Environmental Protection Agency  
Region VII  
726 Minnesota Avenue  
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July 1998

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## **1.0 Site Name, Location, and Description**

This Record of Decision (ROD) has been developed by the United States Environmental Protection Agency (EPA) to select a remedial alternative for the ground water at the Oronogo/Duenweg Mining Belt Site in Jasper County, Missouri (commonly known as the Jasper County Site, herein the "Site"). This ROD is published in accordance with the requirements of Section 117 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, also referred to as the Superfund Law), 42 U.S.C. §9617.

The Jasper County Site is part of the Tri-State Mining District, which covers hundreds of square miles in southwestern Missouri, southeastern Kansas, and northeastern Oklahoma. Mining, milling, and smelting of lead and zinc ore date back to 1850 and continued in the district until the 1970s. The Missouri portion of the district accounted for more than 0.2 billion short tons of ore, 80 percent of which was produced in Jasper County. Processing of the ore resulted in approximately 150 million short tons of wastes. Mining, milling, and smelting activities generated several types of waste materials including mine wastes (waste rock, development rock, and overburden), mill wastes (chat and fine tailings), and smelter-related materials (slag, fugitive dust, and air emissions). Approximately nine million tons of mining/milling and smelter wastes remain on the surface at the Site and contain residual heavy metals, particularly lead, cadmium, and zinc. These wastes currently contribute metals contamination to surface soils, surface water, and ground water. Additionally, most mining occurred underground at depths up to 400 feet resulting in hundreds of mine shafts, many miles of mine adits, and vast underground voids throughout the Site. These mine openings create conduits for migration of metals contamination into the ground water from the surface, as well as, highly oxygenated water which tends to dissolve residual minerals in the rock formations. Residual mineral deposits left in the mines also contribute to the ground water contamination.

Ground water addressed by this ROD is located within the Jasper County Site, which is part of the Tri-State Mining District and is shown on Figure 1. The Site lies within an area bounded on the north by the township line between Townships 29 and 30 North, on the south by the county line between Jasper and Newton Counties, but also including portions of Section 24 Township 27 North Range 34 West and Sections 19 and 20 Township 27 North Range 33 West in Newton County, on the west by the State line between Missouri and Kansas, and on the east by the range line between Ranges 31 and 32 West. The Site encompasses several small- to medium-size municipalities and the surrounding unincorporated areas. Land use varies from agricultural to urban. Approximately 60,000 people live within the Site boundaries, and the EPA has identified that at least 650 residential homes utilize shallow ground water wells for drinking water supplies within the Site. Most of these homes are located in the unincorporated areas of the Site, and most are located in the Oronogo/Duenweg Designated Area east of Joplin, Missouri.

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## **2.0 Site History and Enforcement Activities**

The EPA added the Site to the National Priorities List (NPL) in 1990. The NPL is the EPA's list of sites which have the greatest contamination and pose the greatest threat to human health and the environment. The Site has been divided into 11 separate designated areas (DAs) for investigation because of its large area, about 270 square miles. EPA conducted a potentially responsible party (PRP) search to identify mining companies that may be responsible for cleanup of the wastes and contamination at the Site. In 1991, the EPA signed an Administrative Order on Consent with a group of nine PRPs to conduct a Remedial Investigation/Feasibility Study (RI/FS) at seven of the DAs of the Site under EPA oversight. EPA conducted the investigations at the remaining four DAs. Results of the investigations indicated that some residents utilizing private shallow water wells for their drinking water supply were consuming water exceeding health-based standards for cadmium, lead, zinc, and manganese.

In December 1993, EPA issued a Unilateral Administrative Order (UAO) to the PRPs to supply bottled water to affected homes. In June 1994, EPA issued a second UAO to the PRPs to conduct if wells were found to exceed health-based standards. These investigations identified approximately 100 affected homes. Approximately 60 affected homes are currently being supplied bottled water by the PRPs, and EPA supplies bottled water to approximately 40 homes.

## **3.0 Highlights of Community Participation**

EPA issued a Proposed Plan to address ground water contamination on March 16, 1998. A 30-day public review and comment period was held from March 16 to April 17, 1998. A public meeting was held on March 24, 1998, at Missouri Southern State College in Joplin, Missouri, to present the Proposed Plan and solicit comments from the public. Additionally, EPA established an Administrative Record which contains supportive documents for this decision. The Administrative Record is available for review during normal business hours at the following locations:

- |   |  |
|---|--|
| 1.01 Joplin Public Library<br>300 Main<br>Joplin, Missouri                | 3. Carl Junction City Hall<br>105 North Main<br>Carl Junction, Missouri  |
| 1.02 Webb City Public Library<br>101 South Liberty<br>Webb City, Missouri | 4. U. S. Environmental Protection<br>Agency<br>Region VII Docket Room<br>726 Minnesota Avenue<br>Kansas City, Kansas |

The Proposed Plan presented to the public provided that EPA would support Public Water Supply District (PWS) #3 and would provide point-of-use treatment units to all other affected homes outside of PWS #3. The community's preferences are an extremely important factor and help determine the final decision to address ground water contamination. The comments received from the public during the comment period and the public meeting indicated the community is not in favor of the point-of-use treatment units, and prefers public water supplies for all affected and threatened homes. Therefore, EPA has modified its decision from that presented in the Proposed Plan to include extension of existing public water supply lines, where practical and cost effective, to eliminate the need for as many point-of-use treatment units as possible. Included in this ROD is a responsiveness summary that responds to significant comments the EPA received from the public during the comment period.

#### **4.0 Scope and Role of Operable Unit**

As discussed above, EPA listed the site on the NPL in 1990. The site was called the Oronogo/Duenweg Mining Belt Site. The Jasper County Site is one of the higher priority sites on the NPL because of the human health risks from exposure to contaminated ground water and surface mining wastes. Due to the large geographic area, EPA divided the Site into 11 separate DAs, which include Snap, Neck/Alba, Thoms, Joplin, Oronogo/Duenweg, Carl Junction, Klondike, Iron Gates, Iron Gates Extension, Belleville, and Waco. In addition, EPA divided the Site into four separate Operable Units (OUs) for clean up activities because contamination was present in more include OU-01, Mining and Milling Waste; OU-02, Smelter Waste Residential Yards; OU-03, Mine Waste Residential Yards; and OU-04, Ground Water.

This ROD for OU-04, Ground Water, is consistent with EPA's decisions for this Site as well as future actions under consideration. One of the first actions undertaken in 1993 was to provide bottled drinking water to residents at risk from exposure to contaminated drinking water. EPA determined that this exposure route was a significant human health risk for this site. One of the purposes of this ROD is to replace the bottled water program with a more permanent water supply. In 1996, EPA issued a ROD for two OUs, the Smelter Waste and Mine Waste Residential Yards (OU-02 and OU-03). Cleanup of contaminated residential soils became a priority in 1994 based on the Missouri Department of Health (MDOH) exposure study of the site. MDOH determined one of the most significant human health risks was exposure to contaminated soils. EPA expects the residential yard soil cleanup to be complete in 2002. The final ROD will address the mining and milling waste, OU-01, and is expected to be issued in 1999. The OU-1 ROD will address ecological risks at the Site created by mining wastes and surface water and may include limited ground water remediation at discrete locations to address the ecological risks created where ground water discharges or contributes to surface water contamination.

The action for contaminated ground water, as addressed by this ROD, is necessary to mitigate the principal threat for OU-04, which is the risk from human consumption of contaminated ground water. The main component is to provide alternate drinking water supplies to residents who are not currently supplied with a public water supply system. Alternate water supplies include hook ups to existing public water supply districts and installing point-of-use treatment units. Other components of the selected alternative include institutional controls to protect future residents from installing shallow ground water wells for drinking water and to monitor homes that have threatened shallow ground water wells due to seasonal variation in water quality. This ROD will terminate the existing bottled water program that serves about 100 homes, who will be provided alternate water supplies.

The bottled water program began during the remedial investigation (RI). A group of nine PRPs conducted the RI with EPA oversight in accordance with an Administrative Order on Consent issued in 1991 at seven of the DAs, while EPA conducted the RI at four DAs. EPA identified residents who drank ground water from the shallow aquifer and determined that some people were drinking contaminated water. These homes were found in the Oronogo/Duenweg, Neck/Alba and Iron Gates Extension DAs. Samples from these residential wells showed cadmium, lead, zinc and manganese at concentrations exceeding acceptable levels established by the Safe Drinking Water Act (SDWA). EPA issued two UAOs, in 1993 and 1994 that required the PRPs to supply bottled water to homes with samples showing contaminated drinking water. In addition, the PRPs were required to locate other potentially affected homes in the Oronogo/Duenweg (O/D) and

Neck/Alba DAs. The PRPs identified areas around the Das known to be hydraulically down gradient from mining areas, reviewed public water supply areas, and located areas known to rely on private wells for water supply. The EPA also required that the PRP's investigate areas believed to be hydraulically up gradient of the O/D DA and to confirm ground water flow directions and hydrologic divides at the site. Two additional sampling efforts followed the initial drinking water evaluation as the study area was expanded around the O/D DA to include potentially hydrologically connected areas. Figure 2 depicts the expanded boundaries of the O/D DA covered by these investigations. If additional contaminated wells are found outside the DA boundaries, the boundaries will be further expanded. The expanded boundaries are included whenever EPA refers to the O/D DA in this ROD.

The ground water sampling activities at the Iron Gates Extension (IGE) DA were conducted in March 1995 by the EPA. Seven households in IGE were found to be using water with metal concentrations above cadmium action levels established under the SDWA. These households were provided bottled water by the EPA.

EPA and the PRPs evaluated the use of water softeners during the extensive sampling efforts in 1993 and 1994. Water treated with in-home water softeners was sampled before and after the softener. EPA determined that the water softeners effectively reduce contaminant concentrations to levels below the established acceptable levels under the SDWA. Thus, bottled water was not provided to homes with water softeners, and subsequent sampling rounds did not include homes with water softeners.

In all, more than 650 households within and around the Neck/Alba DA, O/D DA, and IGE DA were contacted to request permission for sampling between December 1993 and May 1994. Some wells within the DAs were not sampled because the residents or owner denied permission to sample wells, water softeners were in use, or no response was received from the residents or owners after two attempts to make contact. Approximately 100 homes that were identified during the investigations as using shallow ground water wells with samples that exceeded the Maximum Contaminant Levels (MCLs) or action levels under the SDWA, have been provided bottled water.

## **5.0 Summary of Site Characteristics**

Ground water within the Site occurs in two aquifers, the shallow aquifer and the deep aquifer, which are separated throughout the region by a confining layer of relatively impermeable rock. The shallow aquifer is comprised primarily of Mississippian Age limestone formations and averages approximately 300 feet in thickness, ranging to a maximum thickness of approximately 400 feet. The confining layer separating the shallow and deep aquifers averages approximately 400 feet in thickness and is composed of Mississippi and Devonian Age shales. The deep aquifer is composed of Cambrian and Ordovician Age sandstone and dolomite formations and ranges up to 850 feet thick and is a confined aquifer overlain and underlain by relatively impermeable materials.

Water yields in the shallow aquifer are highly variable and, on a site-wide basis, are predominantly dependent on secondary permeability features within the rock formations. Secondary permeability results from solution enlargement along bedding planes or fractures and has also been created in areas of extensive interconnected mine workings or mine collapse. Mining at the site generally occurred above and within the shallow aquifer. Most water production from the shallow aquifer, up to several hundred gallons per minute (gpm), occurs in areas where secondary permeability is present. Without the secondary permeability, water yield is very low. Recharge of the shallow aquifer occurs through infiltration of precipitation on the surface through permeable rock layers. Recharge is greatest in mined areas and areas with large amounts of secondary permeability, and is fairly rapid as precipitation infiltrates quickly and is transmitted along underground openings.

Shallow aquifer ground water at the Site is generally neutral to alkaline with a pH ranging from 6.2 to 8.0. Table 1 summarizes the ranges of concentrations of selected metals found in shallow aquifer ground water during the Jasper County RI. These metals are subject to regulation in public water supplies. Table 1 also shows the MCL acceptable for public drinking water supplies in accordance with the SDWA. Average concentrations of these contaminants in shallow aquifer wells at the Site ranged from approximately 1.5 times to 10 times greater than corresponding concentrations in wells located outside the mined areas. In addition, average concentrations exceeded the acceptable levels under the SDWA for cadmium, lead and zinc.

Shallow aquifer ground water is used as a source of drinking water in those areas of the Site without access to public supplies. Shallow aquifer ground water is also used in western Jasper County for watering livestock and gardens, and for industrial purposes, and may, in a few instances, be used for consumption where residents chose not to hook up to available public water supplies.

Sources of contamination in the shallow aquifer are the exposed ore surfaces within the inactive mining operations. Mining exacerbated any contamination from natural mineralization by increasing the extent of contamination through infiltration of highly oxygenated water that mobilizes residual metal bearing minerals. Precipitation on huge volumes of surface mining wastes also mobilizes contaminants which may enter the shallow aquifer. Approximately, nine million tons of on-site surface mining wastes contribute to the ground water pollution problem.

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**Table 1**  
**Concentration of Selected Metals in Shallow and Deep Aquifers**

Constituent	Minimum (mg/L)	Maximum (mg/L)	Average (mg/L)	MCL (mg/L)	No. of Samples Exceeding MCLs
Shallow Aquifer Ground Water (a)					
Arsenic	ND	0.018	0.003	0.05 (b)	0
Cadmium	ND	0.22	0.01	0.005 (b)	39
Lead	ND	0.29	0.016	0.015 (c)	34
Manganese	ND	6.88	0.32	0.05 (d)	80
Nickel	ND	0.13	0.016	0.10 (b)	2
Zinc	0.008	21.8	1.6	5.0 (d)	16
Deep Aquifer Ground Water (e)					
Arsenic	ND	ND	ND	0.05 (b)	0
Cadmium	ND	0.005	0.001	0.005 (b)	0
Lead	ND	0.01	0.003	0.015 (c)	0
Manganese	ND	0.03	0.009	0.05 (d)	0
Nickel	ND	0.02	0.01	0.10 (b)	0
Zinc	ND	0.35	0.06	5.0 (d)	0

Notes: This table summarizes two rounds of site characterization data collected during the RI (D&M, 1995). All results are for total metals analysis. To calculate average, one-half of the reporting limit was used for ND.

MCL = Maximum Contaminant Level acceptable according to the Safe Drinking Water Act (SDWA)  
mg/L = Milligram per Liter

ND = Not present above analytical detection limits

(a) = Data from RI, 173 samples

(b) = Federal Primary MCL, risk-based

(c) = Not an MCL, but is an action level for lead under the SDWA

(d) = Secondary MCL, not risk-based

(e) = Data from RI, 22 samples

The vast underground mine voids contain mine water pools. The mine water pools form acid mine drainage due to the residual metals in the mines, which further contaminates ground water. Mining increased secondary permeability in the ground water and thus, accelerated the transport of contaminants. Secondary permeability from mining voids, shafts and adits also increases the water yield, which increases the availability of the contaminated shallow aquifer as a drinking water source.

The deep aquifer is recharged by precipitation to the formations where they outcrop in the Ozark region, well to the southeast of Jasper County. Another potential source of recharge to the deep aquifer may be downward leakage from the shallow aquifer in areas where abandoned or deteriorating wells, exploratory drill holes and mine shafts penetrate through the confining layer. During the RI, efforts were made to identify deep aquifer wells that penetrated the unit. Other than pumped wells, the deep aquifer has no apparent discharge to the surface at the Site. The source of potential contamination in the deep aquifer is its interconnection with the shallow aquifer, which is generally via the deep wells. Thus, potential contamination of the deep aquifer may be mitigated by careful control of the deep wells within the Site.

Deep aquifer water is of a calcium-bicarbonate type with secondary magnesium, as is typical of a dolomitic aquifer. Metal levels in the deep aquifer water are typically low with maximum contaminant concentrations below the MCLs or action levels for all metals as shown in Table 1. Cities or communities that derive their water supply from deep aquifer wells are: Alba, Neck City, Carl Junction, Carterville, Duenweg, Oronogo, Purcell, and Webb City. Joplin, the largest population center, derives the majority of

its water supply from surface water sources (Shoal Creek). Also, approximately 1,800 rural households in the area receive water from the deep aquifer through public water supplies wells.

## **6.0 Summary of Site Risks**

In general, EPA has determined that the principal threat for this OU is the human health risk from ingestion of ground water contaminated with metals from mining and milling sources. These determinations are based on the analysis in the risk assessment and data collected during the remedial investigation. The contaminants of concern in the ground water include lead, cadmium, and other heavy metals. EPA has determined that the actual or threatened release of hazardous substances, such as lead, cadmium, manganese, nickel, and zinc, may present an imminent and substantial endangerment to public health, welfare, or the environment if not addressed by implementing the Selected Remedy.

The remedial objective of this ROD, therefore, is to prevent the identified, unacceptable human health risks due to ingestion of or exposure to site-related contaminants in ground water. This ROD does not distinguish between shallow and deep aquifer ground water as to its purpose. The objective is to prevent or reduce potential ground water-related human health risks irrespective of which aquifer residents may be using for water supplies.

The risk assessment methodology and results are briefly described below. EPA encourages the reader to review the Risk Assessment Report and the RI Report in the Administrative Record.

### **6.1 Methodology**

In 1995, the MDOH conducted a baseline risk assessment for the Site under a cooperative agreement with the EPA. The assessment examined risks related to human exposure to metals in various media, including the ingestion of metals in drinking water. Since most residents at the Site who consumed ground water obtained their drinking water from municipal water systems drawing water from the deep aquifer, deep aquifer ground water was evaluated in the risk assessment as a drinking water source. Ingestion of shallow aquifer water was not addressed because residents found to be consuming water containing metals above risk-based action levels have been supplied with bottled water. It was assumed, for the purposes of the risk assessment that Site residents showered or bathed in shallow aquifer ground water, and thus, were potentially exposed to metals via dermal absorption.

Results for 21 samples of deep aquifer ground water were used to characterize the drinking water source. The drinking water samples contain very low concentrations of cadmium, copper, lead, manganese, nickel, and zinc; these metals were identified as contaminants of concern (COCs) in deep aquifer drinking water. For the shallow aquifer, the COC list also included arsenic. As a result of the extensive RI and two subsequent sampling efforts, 553 samples were aquifer groundwater. Concentrations of most COCs were higher in the shallow aquifer samples, compared to levels in the deep aquifer, as shown above in Table 1.

The available data regarding COC concentrations in ground water were used in conjunction with the results of a demographic study conducted as part of the RI investigation to obtain ambient temperatures, inhalation during showering was not considered to be a complete exposure pathway. Also, since most metals are not readily absorbed through the skin, the evaluation of the dermal exposure pathway was limited to two COCs, cadmium and arsenic.

In the risk characterization, exposure and metals toxicity were summarized and integrated into quantitative and qualitative expressions of risk. Estimated metal intakes were compared to toxicity values in order to characterize noncarcinogenic effects. For estimating carcinogenic effects, estimated intakes and chemical-specific dose-response data were used to calculate the probabilities of an individual developing cancer over a lifetime. Exposures to lead were assessed separately, through the use of EPA's Integrated Exposure Uptake Biokinetic Model (IEUBK). The IEUBK model was designed to model exposure from lead in air, water, soil, dust, diet, and other sources with pharmacokinetic modeling to predict blood lead levels in children six months to seven years old.

Noncancer hazard quotients were calculated for the ingestion and dermal absorption pathways. Hazard quotients for each pathway were summed to give a pathway hazard index, and pathway hazard indices were summed in a Total Hazard Index. According to the "Risk Assessment Guide for Superfund," human health risks may exist when the Total Hazard Index exceeds 1.0.

### **6.2 Results: Shallow Aquifer Risks**

The noncarcinogenic hazard indices for dermal absorption of cadmium and arsenic in shallow aquifer water were negligible for all adult and child scenarios evaluated. An analogous series of calculations were made for dermal exposure to arsenic, a carcinogen, to estimate a Total Excess Lifetime Cancer Risk.

The Total Excess Lifetime Cancer Risk estimated for the dermal absorption of arsenic was low, with a maximum of  $2.3 \times 10^{-7}$  (adults), which is less than the  $1 \times 10^{-6}$  (one in a million) point of departure identified in the NCP for consideration of remedial action. Dermal absorption of lead is not an input in the model because lead is not readily absorbed through the skin. In summary, the risk assessment did not identify significant risks associated with dermal exposure to water from the shallow aquifer.

The shallow aquifer contains average concentrations of some contaminants of concern that exceed the acceptable drinking water levels, e.g., lead, cadmium, manganese, and nickel identified under the SDWA (see Table 1). These contaminants are hazardous substances. The SDWA action levels, or MCLs, are health-based criteria established for public water supply systems based on toxicological studies. The risk assessment assumed that consumption of shallow aquifer ground water that exceeds the primary MCLs or the lead action level presents unacceptable human health risks.

### **6.3 Results: Deep Aquifer Risks**

The pathway hazard index for ingestion of five noncarcinogenic metals in deep aquifer drinking water ranged from 0.08 to 0.2 for adults under reasonable maximum and average exposure scenarios. For children, the pathway hazard for all scenarios ranged from 0.13 to 0.46. These hazard indices, which are significantly less than 1.0, indicate that noncarcinogenic risk for ingestion of drinking water from the deep aquifer is low. Carcinogenic risk through exposure to arsenic in drinking water was not evaluated because arsenic was not detected in deep aquifer ground water RI sampling activities and is not considered a contaminant of concern.

The results of the IEUBK predictive blood lead modeling indicated that ingestion of drinking water from the deep aquifer by children was a minor pathway of lead exposure, accounting for only about four percent of total lead uptake. Dermal absorption of lead is not an input in the model because lead is not readily absorbed through the skin.

### **6.4 Ecological Risk**

An ecological risk assessment is currently being conducted for the Site, and is expected to be finalized in the near future. The investigations conducted to date indicate that contaminated ground water contributes significant risk to the ecosystems at the Site through discharge to surface water. This ROD deals specifically with the human health risk from exposure to contaminated ground water. All ecological risks identified at the Site will be addressed in a subsequent ROD for the mining wastes (OU 1).

## **7.0 Remedial Action Objectives**

Remedial Action Objectives (RAOs) are specific goals for preventing excessive risks and protecting human health. The ground water RAOs presented in this section reflect the current understanding of site conditions and potential exposure pathways based on site characterization data and Human Health Risk Assessment findings. Specifically, ground water RAOs for the Jasper County Site are developed to address current and future potential human health risk from exceedances of risk-based action levels in public and private domestic water wells. A future ROD may contain limited specific ground water remedial actions to address localized ground water contributions to the ecological risk.

As set forth by the National Contingency Plan (NCP), the threshold determination of whether remedial action is required at CERCLA sites is based on the presence of unacceptable risks. The risk-based action levels used to make the determination of unacceptable risk for the Ground Water OU at the Jasper County Site consist of the federal primary MCL for cadmium and the SDWA action level for lead. For purposes of this ROD, potential risks to human health are assumed to be unacceptable when the following conditions exist within the DAS of the Site:

- Statutory, risk-based action levels are exceeded in current or future domestic water supplies.
- Domestic water supplies are threatened with exceeding action levels by the migration of contaminants in site ground water.

Based on results of ground water surveys conducted during the RI, one RAO is deemed adequate to address potential, ground water related human health risks at the Jasper County Site. The sole RAO for the Ground Water OU is as follows:

- Prevent unacceptable human health risks due to ingestion of or exposure to site-related contaminants in ground water.

This RAO is not intended to distinguish between shallow and deep aquifer ground water. The intent of the RAO is to establish an objective to prevent or reduce all potential ground water related human health risks irrespective of which aquifer residents may be using for domestic water supplies.

## **8.0 Description of Alternatives Evaluated**

EPA developed and evaluated five alternatives during the feasibility study (FS). Each alternative addresses the provision of alternate water supplies for homes using drinking water from threatened or contaminated private shallow water wells. Treatment, containment, and other physical controls to remediate the ground water were not fully developed and evaluated. During the initial screening of technologies, EPA determined that design of a treatment or containment system for the contaminated aquifer would be nearly impossible because the contamination is widespread and the aquifer unit is characterized by numerous fractures and openings. Additional discussion on the technical impracticability of ground water remediation is provided in Attachment 1 of this ROD.

The No Action alternative, also was evaluated, however, EPA believes that the No Action alternative is not protective of human health and does not consider it a viable option. The No Action alternative and the four action alternatives are described in Table 2. Alternatives 1, 3, 4, and 7 are easily implementable and could be completed within one year. Alternative 6, as presented in the FS, would be difficult to implement since it would require establishing new rural water districts and annexing land into various municipalities. It is estimated that Alternative 6 would require three to six years to complete.

In response to comments received from the public, EPA developed and evaluated a modified version of Alternative 6, called Alternative 6A, which is the Selected Remedy in this ROD. In general, Alternative 6A modifies Alternative 6 by including additional homes for the public supply systems and reducing the number of homes that receive point-of-use treatment systems. Section 10 contains a complete description of the Selected Remedy. Alternative 6A is included in this summary to complete the comparative analysis.

In general, the major applicable, relevant and appropriate requirements (ARARs) for clean up of contaminated ground water at this site are the federal and state drinking water standards under the SDWA. These ARARs are associated with each of the six clean up alternatives EPA evaluated in detail.

**Table 2**  
**Alternative Descriptions**

No.	Alternative Name	Alternative Assumptions and Descriptions	Alternative Cost**
1	No Action	<ul style="list-style-type: none"> <li>* The current bottled water program would be discontinued.</li> <li>* No other actions would be implemented.</li> </ul>	None
3	Bottled Water Plus Institutional Controls and Monitoring	<ul style="list-style-type: none"> <li>* The current bottled water program in the expanded O/D, Neck /Alba, and IGE DAS would be continued until the plans are implemented and needed infrastructure is available to provide public water to affected households. It is assumed that public water supplies will become available throughout the DAS within 10 years, except in the newly created PWSD No. 3, where public water supplies are expected to be provided within 1 year, and the Joplin annexation area, where public water supplies are expected to be provided within 5 years.</li> <li>* Drilling new shallow domestic water wells would be restricted in affected areas of the site through a program of institutional controls.</li> <li>* An institutional control would be implemented to ensure the continued high quality of deep aquifer ground water into the future. This institutional control would consist of enforcing the aquifer protection provisions of the existing Missouri Well Driller's Law ensuring proper casing depth, casing integrity, and proper abandonment of any existing or new water supply wells.</li> <li>* The shallow well monitoring program would be implemented to evaluate threatened domestic wells subject to seasonal variations in water quality. An attempt would be made to sample all households with existing water softeners, which previously denied access, or did not respond. Those households with exceedances of risk-based action levels would be provided bottled water until a public water supply becomes readily available.</li> </ul>	\$507,193
4	Point-of-Use Treatment Systems Plus Institutional Controls and Monitoring	<ul style="list-style-type: none"> <li>* Point-of-use treatment systems such as water softeners or RO units would be installed in all affected households, except for those households within the boundaries of the newly formed PWSD No. 3.</li> <li>* Households within the boundaries of PWSD No. 3 would be provided with bottled water until the district's infrastructure is constructed and water supplies become available.</li> <li>* This alternative assumes that public water supplies will become available throughout the DAS within 10 years, except in the newly created PWSD No. 3, where public water supplies are expected to be provided within 1 year, and the Joplin annexation area, where public water supplies are expected to be provided in 5 years. The same institutional controls, monitoring program, and remedial design phase sampling program implemented under Alternative 3 would also be implemented; however, the monitoring program for Alternative 4 would include confirmatory sampling, of the point-of-use treatment systems to verify that risk reduction goals are met. Households with exceedances identified in the remedial design phase sampling program would be included in the remedial action.</li> </ul>	\$533,444

No.	Alternative Name	Alternative Assumptions and Descriptions	Alternative Cost **
6	Public Water Supplies for All Households with Exceedances Plus Institutional Controls and Monitoring	<p>* Affected households in the site would be provided with public water supplies through construction of public water supply distribution systems.</p> <p>* The current bottled water program would continue throughout the areas until the plans are implemented and needed infrastructure is constructed. It is assumed public water supplies could be constructed within 5 years.</p> <p>* The same institutional controls, monitoring program, and remedial design phase sampling program implemented under Alternative 3 would also be implemented. Households with exceedances identified in the remedial design phase sampling program would be included in the remedial action.</p>	\$1,436,403
6A	Public Water Supplies for Affected and Threatened Households and Point-of-Use Treatment Units for Remote Households Plus Institutional Controls and Monitoring	<p>* Both affected and threatened households in the site would be provided with public water supplies through construction of public water supply distribution systems.</p> <p>* Affected households in the site to remote to be provided with public water supplies would receive point-of-use treatment units.</p> <p>* The current bottled water program would continue throughout the areas until the plans are implemented and needed infrastructure is constructed. It is assumed public water supplies could be constructed within 1 to 2 years.</p> <p>* The same institutional controls, type of monitoring program, and remedial design phase sampling program implemented under Alternative 3 would also be implemented. Households with exceedances identified in the remedial design phase sampling program would be included in the remedial action.</p>	\$2,711,736
7	Public Water Supply District No. 3 Plus Point-of-Use Treatment Systems, Institutional Controls, Monitoring	<p>* Public water supplies would be made available to all households in the O/D DA that are located within the expanded service area of PWSD No. 3 through the remedial action. Affected households that are not located within the expanded PWSD No. 3 service area would be provided with point-of-use treatment systems.</p> <p>* Households within PWSD No.3 service area that are currently receiving bottled water would be provided with bottled water until the district's infrastructure is constructed and water supplies become and available.</p> <p>* The same institutional controls, monitoring program, and remedial design phase sampling program implemented under Alternative 4 would also be implemented under Alternative 7, although the number households to be monitored would be different from the other alternatives. Households identified as affected during the design phase sampling program would be included in the remedial action.</p>	\$1,236,857

\*\* Costs include present worth of capital cost, operation and maintenance, monitoring, and remedial design sampling.

## 9.0 Summary of the Comparative Analysis of Alternatives and Rational for The Selected Alternative

The NCP, 40 C.F.R. Section 300, requires EPA to evaluate remedial alternatives against nine criteria to determine which alternative is preferred for clean up. EPA performs this analysis during the FS. The detailed analysis in the FS Report provides an in-depth analysis of the five alternatives compared against the nine criteria. An alternative must satisfy all nine criteria before it can be selected. The first step to meet is the threshold criteria, which are overall protection of public health and the environment and compliance with ARARs. In general, alternatives that do not satisfy these two criteria are rejected.

The second step is to compare the alternatives against a set of balancing criteria. The NCP establishes five balancing criteria which include long-term effectiveness and permanence; reduction in toxicity, mobility, or volume achieved through treatment; implementability; short-term effectiveness; and cost. The third and final step is to evaluate the alternatives on the basis of modifying criteria, which are state and community acceptance. EPA has received significant public comment on the plan for remedial action we proposed in March 1998. On the basis of the comments received. EPA developed Alternative 6A and it is included in this summary.

EPA has determined that Alternative 6A is the alternative that best achieves the nine criteria. The FS, the detailed analysis of alternatives, and the comments from the public support this decision. The following briefly summarizes the rationale for the selected alternative by profiling the alternatives against the nine criteria and highlighting how the selected alternative compares to the others.

### 9.1 Threshold Criteria

The following presents a brief description of how the alternatives satisfy the threshold criteria of overall protection of public health and the environment and compliance with ARARs.

#### 9.1.1 Overall Protection of Human Health and the Environment

This criterion provides an overall assessment of whether an alternative meets the requirement that it is protective of human health and the environment. The overall assessment of protection is based on a composite of factors from other criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Alternatives 3, 4, 6 and 7 in the FS Report and EPA's Alternative 6A will protect human health and the environment to varying degrees. However, Alternative 1, the No Action usefulness as a baseline alternative.

To protect human health and the environment, Alternative 4, Treatment Units relies on long-term monitoring of threatened private drinking water wells. Alternatives 6, 6A, and 7, have public water systems that do not need to monitor private drinking water wells. Under Alternative 4, exposure to contaminants may occur between sampling events or monitoring may fail to detect occasional exceedances due to fluctuating metal concentrations. Residents with threatened wells that are connected to a public water supply system would not be subjected to this potential exposure scenario. In addition, Alternatives 6, 6A, and 7 include water line connection fees, not included in Alternative 4. Connection fees funded as part of the remedy would assure more people will be connected to a public water supply system which will permanently reduce risk. Alternative 4 relies on affected residents to pay the connection fee when, and if, it becomes available in the future.

Alternative 3, Bottled Water, is only moderately protective of human health because bottled water use cannot be assured, readily monitored or controlled. Under Alternative 3, untreated shallow ground water remains readily available for consumption in homes receiving bottled water. There would be no means of ensuring the bottled water is being used as intended. Alternatives 4, 6, 6A, and 7 are protective of human health because household water would be treated with point-of-use treatment units or supplied through a public water distribution system, thereby ensuring treated water is available. Some households may elect not to use public water supplies due to the monthly water bill under Alternatives 6, 6A, and 7. Also, some households may elect not to use the point-of-use treatment units.

The point-of-use treatment systems prescribed under Alternatives 4 and 7 could be installed in less than six months. The public water supply components of Alternative 6A and 7 are expected to start providing public water within six months to a year. Alternative 6 would gradually decrease the number of homes where untreated tap water is available over a three-year period. Alternative 6A would provide permanent protection to the most residents in the shortest amount of time. Alternative 6A provides a permanent public water supply that assures protection of human health because suppliers will be subject to the requirements of the Safe Drinking Water Act, which safeguards public water supplies in the United

States.

Through design-phase sampling and monitoring programs, all the alternatives address the possibility that there may yet be some unidentified homes using shallow ground water with unacceptable levels of contaminants. However, the number of unidentified affected wells will be reduced under Alternative 6A because most households, whether affected, potentially unidentified affected, or unaffected but threatened, within the PWS No. 3 expanded service area and within the area of extended water lines from the Missouri American Water Company will be supplied with public water.

The institutional controls prescribed under all the retained alternatives would provide effective protection for future residents and are considered readily implementable.

#### **9.1.2 Compliance With ARARs**

This criterion is used to decide how each alternative meets federal and state ARARs, as defined in CERCLA Section 121. Compliance is judged with respect to chemical-specific, action-specific, and location-specific ARARs as well as appropriate criteria, advisories and guidance. A list of ARARs identified for each alternative is in the FS Report.

None of the alternatives under consideration provide for cleanup of the ground water aquifer to drinking water standards because aquifer remediation is considered technically impracticable. Thus, none of the candidate alternatives can comply with the chemical-specific ARARs. A technical impracticability waiver of chemical-specific ARARs is necessary to select a remedy for active clean up of the ground water at this Site. Attachment 1 provides a detailed discussion of the technical impracticability of remediating the ground water. The justification for a waiver would be based on the technical complications at the site that make ground water clean up impractical, such as karst topography, heterogeneity of the shallow aquifer formation, the large areas of secondary permeability features including the solution enlargement along bedding planes, fractures, and collapse of rock formation. In addition, extensive interconnected mine workings that occur generally above and within the shallow aquifer, the nature and extent of contamination, and other factors also contribute to the impracticability of ground water cleanup to meet ARARs. Although the availability of alternate water supplies by a public system or by individual home water treatment systems, as described in Alternatives 4, 6, 6A, and 7, would provide adequate drinking water to the affected residents at this Site, the availability of such alternate water supplies does not obviate the need for a waiver of chemical-specific ARARs.

No location- or action-specific ARARs were identified for Alternative 3 and 4. Compliance with location- and action-specific ARARs would have to be addressed during remedial design of Alternatives 6, 6A, and 7 which require construction of public water systems. However, no remedial design problems resulting in noncompliance are anticipated.

### **9.2 Balancing Criteria**

The following presents a brief description of how the alternatives developed in the FS satisfy the balancing criteria.

#### **9.2.1 Long-Term Effectiveness**

This criterion addresses the results of a clean up action in terms of the risk remaining at the Site after the goals of the clean up have been met. The primary focus of this evaluation is to determine the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes.

Assuming appropriate institutional controls are implemented and enforced and households with water known to exceed action levels participate in the prescribed drinking water programs, potential human health risks would be reduced to approximately equivalent levels under Alternatives 4, 6, 6A, and 7.

Under Alternatives 4, 6, 6A, and 7 water used by a household would be treated. Therefore, these alternatives would be reliable in preventing ingestion of site-related contaminants. However, the long-term reliability of the water treatment units require that they be monitored and replaced periodically. Under Alternatives 4 and 7, reverse osmosis (RO) units would treat only the water at the taps where they are installed, which allows the consumption of untreated shallow ground water from other untreated taps in the home. Alternative 3 requires bottled water for drinking and cooking; however, the water at the tap would still exceed action levels and could be consumed by residents for whom bottled water is an inconvenience.

Providing treated water through public water distribution systems under Alternatives 6, 6A, and 7 is a highly permanent remedy. A public water system's infrastructure is expected to provide adequate water indefinitely. The effectiveness and reliability of the point-of-use systems under Alternatives 4 and 7 would be monitored to ensure compliance with drinking water standards. Also, under Alternatives 3, 4, and 7, it is assumed that all households within the affected areas of the site will have access to a public water supply within a 10-year period.

None of the alternatives propose ground water treatment to address water quality in the aquifer. Therefore, none of the alternatives would reduce the volume or concentrations of site-related contaminants in the aquifer. Alternatives 3, 4, 6, 6A, and 7 all rely on implementing institutional controls and monitoring to address residual risks associated with leaving contaminants in the shallow aquifer.

#### 9.2.2 Short-Term Effectiveness

This criterion addresses the effects of the alternative during the construction until the clean up is completed and the selected level of protection has been achieved.

All households in the site known to be using shallow aquifer water exceeding risk-based action levels are receiving bottled water. Alternative 3 has been implemented except for the prescribed monitoring and institutional controls programs. Alternatives 4, 6A, and 7 can be implemented within six months to two years. Alternative 6 would require approximately three years to fully implement. During the implementation period for Alternatives 4, 6, 6A, and 7, the bottled water program would continue. Alternatives 4 and 7 provide the greatest degree of protection during the implementation phase because, for most homes, the entire water supplies of affected households can be treated within a relative short time frame. Alternative 6A could be implemented within one or two years. Reliance on bottled water during the longer implementation phase of Alternative 6 and 6A exposes those residents to potential risks unless they continue to use bottled water exclusively.

#### 9.2.3 Reduction of Toxicity, Mobility, or Volume

This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility or volume of the contaminants.

None of the alternatives provide for ground water treatment as a means to reduce the volume or concentrations of site-related contaminants in the aquifer. Treatment of the contamination in the aquifer is considered technically impracticable.

#### 9.2.4 Implementability

This criterion addresses the technical and administrative feasibility of implementing a cleanup and the availability of various services and materials required during its implementation. All the alternatives are readily implementable. The technical aspects of providing alternative water supplies or point-of-use treatment are implementable under all alternatives. Alternative 6 will require planning, remedial designs, and various civil construction projects. In contrast, the design and planning of the PWSD under Alternative 6A and 7 is mostly completed. Alternative 6A will require design of the extended existing public water lines, but considered readily implementable. Alternatives 3 and 4, providing bottled water or water softeners, require little in the way of design or construction.

Providing public water supplies under Alternatives 6 is expected to be administratively implementable but difficult. Establishing new rural water districts represents a significant administrative undertaking.

The monitoring programs and institutional controls prescribed under Alternatives 3, 4, 6, 6A, and 7 are expected to be readily implementable.

#### 9.2.5 Cost Effectiveness

This criterion addresses the direct and indirect capital cost of the remedy. Operation and maintenance costs incurred over the life of the project, as well as present worth costs, are also evaluated.

Of the alternatives under consideration, Alternative 4 is a cost-effective remedy because it addresses all current and future human health concerns while meeting ARARs at a low cost. However, Alternative 4 is not very effective in the long term because of the need to monitor and replace the point-of-use treatment units. At \$2.7 million, the estimated cost of Alternative 6A is the highest of

all the alternatives evaluated. In addition, the increase in reliability and permanence with Alternative 6A make it cost-effective. The cost of Alternative 6, at \$1.4 million and Alternative 7 at \$1.2 million would be lower. The costs of Alternatives 3 and 4 are estimated at approximately \$507,193 and \$533,444, respectively.

### **9.3 Modifying Criteria**

The following presents a brief description of how the alternatives developed in the FS satisfy the modifying criteria.

#### **9.3.1 State Acceptance**

This criteria addresses MDNR's preferences or concerns about the Site remedial action alternatives. The EPA is the lead Agency and has coordinated all Site activities with MDNR throughout this project. MDNR concurred on the Proposed Plan issued by EPA in March 1998, which proposed Alternative 7. However, subsequent to receiving comments from the public on the Proposed Plan and new information concerning existing water lines in the affected areas of the O/D and IGE DAS, MDNR has expressed to EPA its preference for less water softeners and more public water supply hookups. MDNR has indicated that Alternative 6A is their preferred selection for the ground water remedy at the Site.

#### **9.3.2 Community Acceptance**

This criteria reflects EPA's perception of the community's preferences or concerns about the selected alternative. The degree of community acceptance of the Preferred Alternative was assessed by EPA in its review of comments received on the Proposed Plan. EPA determined that the public prefers hookups to public water supplies for all affected and threatened homes over point-of-use treatment units. EPA has very carefully considered the public comments in selecting the remedy for the Site. With due regard to community participation, EPA has determined that Alternative 6A is highly favored among the affected residents and the community leaders because it is the most permanent and reliable source of alternate water supply.

### **10.0 The Selected Remedy**

Based on comments received from the public during the review period, EPA has selected a modified version of Alternative 6 as the remedy for ground water at the Site. The Alternative 6A consists of several components including: (1) implementing the PWSD #3 to provide public water supplies within a portion of the O/D DA; (2) extension of existing of existing public water supplies mains to provide public water to other affected and threatened households within the O/D and IGE DAS; (3) providing a whole house treatment unit to affected homes within the O/D, Neck/Alba, or in IGE DAS that cannot cost effectively be served by public water supplies; (4) a service contract to maintain the treatment units; (5) a monitoring program to periodically sample residences in the affected are not currently exceeding action levels and not hooked up to a public water supply; and (6) institutional controls to protect future residents from drinking contaminated ground water.

Alternative 6A differs from Alternative 6, which provided for public water supply hookups only for those homes with current exceedances of the action levels and monitoring of the threatened private water wells. Alternative 6A provides that the threatened residences, where economically feasible, will also be connected to a public water supply. In addition, Alternative 6 provided for establishing new public water supply districts. Alternative 6A relies on the recently formed PWSD #3 and existing water supply lines from Missouri American Water Company (a private water purveyor in Jasper County) thereby eliminating the administrative burden of establishing new rural water districts. A detailed description of Alternative 6A is summarized below.

#### **10.1 Public Water Supplies**

The affected and threatened homes that will be supplied with public water distribution under the Alternative 6A are identified on Figures 3 and 4 within the O/D and IGE DAS. Approximately 176 homes in the O/D DA are located within boundaries of PWSD #3 and will be hooked up to the district's water supplies. Another 19 homes are located very near the PWSD boundaries and will also be connected to the district's water mains. These households are located west and south of the PWSD along Hawthorne Road, along the main line from Carterville to the PWSD, southwest of the PWSD near Joplin, and south of the PWSD near Duenweg. Eight homes are located along the western Webb City City limits and will be connected to the Webb City public water system. Additionally, 117 households in the southwestern portion of the O/D DA and 28 households in the IGE DA will receive public water from expansion of Missouri American Water Company's existing water supply distribution system. All together, approximately 348 homes will be connected to a public water supply. The location of these homes are also shown on Figures 3 and 4.

EPA found from sampling efforts that numerous wells within affected areas had water samples within acceptable levels for drinking water. However, EPA believes these wells are threatened and may exceed standards in the future or during seasonal fluctuations. Under Alternative 6A, households that currently do not exceed action levels, yet are threatened, will be hooked up to public water along with the affected homes. Making public water supplies available to these households would eliminate the need to include these households in the long-term monitoring programs prescribed under this alternative.

## **10.2 Point-of-use Treatment Units**

Approximately 15 homes in the O/D DA lie outside the expanded PWSD service area and outside areas that could be cost effectively connected to Missouri American Water Company mains. Three of these households were found to exceed action levels and will be provided with whole house point-of-use water treatment systems. One house in Neck/Alba DA and one in the IGE DA will also receive whole house water treatment systems since they are located at least one mile away from existing water mains. The total number of homes receiving point-of-use treatment systems under this alternative will be five. The proposed water treatment systems will consist of a sodium chloride charged residential water softener. EPA found during the sampling events in Jasper County and the remedial actions conducted in Cherokee County, Kansas, (immediately west of the Jasper County Site) that sodium chloride water softeners are very effective at reducing metals concentrations in ground water in the Tri-State mining district to safe levels. In order to ensure that the point-of-use treatment units are maintained, functioning properly, and effectively reducing metals concentrations to safe levels, EPA will establish a service contract with the treatment unit supplier to maintain the units until such time that public water becomes available for these homes. When public water supplies are economically available to these households, EPA will provide hookups to the public supply.

## **10.3 Monitoring Program**

Alternative 6A includes a monitoring program to periodically monitor homes with shallow water wells that are threatened with exceedances but currently have acceptable drinking water levels and will not be connected to a public water supply system because of their distance from existing water mains. These residences are generally located in the central and southern portion of the O/D DA. All homes within the affected areas not hooked up to public water or supplied with a treatment unit will be included in the program. The program will include households located within existing public water supply districts not currently hooked up to those systems. The monitoring program for Alternative 6A, as discussed in Section 8.2, will also include the confirmatory sampling of the newly installed point-of-use treatment systems. Confirmatory monitoring of the in-house treatment units is prescribed to evaluate the effectiveness of the treatment units through sampling at reducing metals concentrations to safe levels. During the remedial design and planning phase of Alternative 6A, a sampling program will be implemented to sample homes outside the areas that can cost effectively be connected to public water supplies. The number of households to receive point-of-use treatment systems will be determined on the basis of these sampling efforts.

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## **10.4 Institutional Controls**

The institutional control component of the Preferred Alternative is necessary to reduce the risks from future use of the shallow aquifer ground water as domestic water supply for new construction or newly installed wells. Institutional controls will ensure that new or existing wells with water samples exceeding safe drinking water acceptable levels are not used for drinking water without prior treatment. Institutional controls may include restrictions on the drilling of new shallow aquifer wells under existing provisions of the Missouri Well Driller's Law, county ordinances governing residential construction, county well permit restrictions, and public education programs. A more detailed discussion of potential institutional controls is presented in Appendix C of the FS.

Additional institutional controls under this Alternative will be to prevent future human health risks due to possible downward migration of site-related contaminants to the deep aquifer from the shallow aquifer. Protecting the deep aquifer from future degradation is needed because contaminants remain in the shallow ground water under Alternative 6A. Contaminants may migrate to the deep aquifer through wells that are deteriorate or are not properly plugged when abandoned. To prevent such contamination of the deep aquifer water, the Selected Remedy recommends strong enforcement of the aquifer protection provisions of the existing Missouri Well Driller's Law that ensure proper casing depth, casing integrity, and proper abandonment of any existing or new water supply wells that reach into the deep aquifer.

## **10.5 Cost**

The cost of Alternative 6A includes the capital costs of constructing part of PWSD #3 to supply to homes within the O/D DA served by the district, and extending existing water supply mains from Missouri American Water Company to other homes in the O/D and IGE DAS. These capital costs include furnishing and installing the water supply mains, lateral distribution lines, and lines and meters needed to connect individual households. The estimated capital costs for this alternative also include providing point-of-use water treatment systems for the households outside the cost-effective reach of public water supplies.

The capital cost of this alternative is estimated to be approximately \$2,518,988. Annual O&M costs for this alternative are assumed to continue for 10 years. The net present O&M cost would be \$175,137 for ten years at a five percent discount rate. These O&M costs include provision of bottled water to affected homes until the selected remedy is implemented, maintenance of the point-of-use treatment units, monitoring and institutional controls. Design phase sampling for Alternative 6A is estimated at \$17,611. The cost estimate for Alternative 6A are presented in Table 3. For cost purposes, the estimate was made for eight inch main, although six or eight inch main may be used for connection to the Missouri American as required by the Public Service Commission.

In the event of public water supply distribution systems are not available in 10 years, year service life for the point-of-use treatment units, the net present worth cost to replace the units and extend the service agreements for an additional 20 years is \$2,312 per household.

## **10.6 Operation and Maintenance**

Operation and maintenance (O&M) costs for this alternative include annual service contracts to maintain the point-of-use treatment systems, administrative costs for program implementation, and any required O&M materials, such as sodium chloride. The costs of operating and maintaining the public water supply are assumed to be borne by the customers of the PWSD through their monthly water bills are not included in the O&M cost estimates for this Alternative 6A.

Point-of-use treatment systems would be maintained as part of the remedial actions until public water supplies are available in areas outside the PWSD service area. Estimated O&M costs are based on the assumption that the public water supplies will be available within the Joplin annexation area in five years and the remaining affected areas within 10 years. However, the installed point-of-use treatment systems would effectively reduce concentrations of site-related contaminants as long as they are needed and are properly maintained.

## **10.7 Five-Year Review**

A five-year review is required at sites where contamination remains above health-based criteria. The review will be conducted in accordance with Section 121(c) of CERCLA, 42 U.S.C. §9621(c), as amended, and applicable guidance and in a manner to assure the continued protection of the public health and environment.

The five-year review of the remedial action will be conducted to ensure that the remedy implemented is effective and accomplishes the goals of the remedial action. The review will include monitoring of the point-of-use treatment units, and installation of new water mains to which the households with treatment units could be hooked up. The review will also examine the success of the institutional controls at the Site area, i.e. the enforcement of the controls on new well construction.

**Table 3**  
**Cost Estimate for Alternative 6A**

Item Description	Unit Cost	Quantity	Total Cost
Capital Costs			
CERCLA Related PWSD #3 Capital Costs			857,250
1 " PVC Main	7 / ft.	17,400	121,800
8" Cast Iron Main	20 / ft.	52,300	1,046,000
House connection & tapping fee	750 ea.	145	108,750
Water Softener/Installation	1,325 ea.	5	6,625
Institutional controls	50,000	1	50,000
Subtotal Direct Capital Costs			2,190,425
Indirect Costs			
Construction Management - 5% of Direct Construction Costs			109,521
Engineering Design - 5% of Direct Construction Costs			109,521
Contingency - 5% (c)			109,521
Subtotal Indirect Costs			328,564
Total Estimated Capital Costs			2,518,988
Operation & Maintenance Estimate			
Bottled Water and Dispenser Rental (years 1 and 2)	375 ea./yr.	123 x 2 yrs.	46,125
Sodium Chloride for Water Softeners (for 10 years)	126 ea./yr.	5 yrs.	6,300
Water Softener Service Contract (for 10 years)	50 ea./yr.	5 yrs.	2,500
Biannual Monitoring (at years 1, 2, 5, and 10)	17,309 /yr.	4 yrs.	69,237
Administration of institutional controls	6,250 /yr	10 yrs.	62,500
Subtotal O&M Costs			186,662
Contingency - 15% (c)			27,999
Total Estimated O&M Costs			214,661
Present Worth of O&M Costs (d)			175,137
Total Present Worth for Alternative 6A (d)			2,694,125

- a. The number of-households in the O/D, Neck/Alba, and IGE DAS receiving Bottled water as of September 1997 is 80.
- b. When a public water supply becomes readily available, households are removed from the bottled water program and a bottle deposit return is shown.
- c. Households identified as affected in the remedial design phase sampling program would be added to the remedial alternative. Costs would be covered by the contingencies.
- d. All net present worth costs in 1997 dollars at 5% discount rate.

## **11.0 Statutory Determinations**

Under its legal authority, EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences. These specify that when complete, the selected remedial action for this Site must comply with applicable or relevant and appropriate environmental standards established under federal and state environmental laws, unless a statutory waiver is justified. The selected remedy also must be cost effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

### **11.1 Protection of Human Health and the Environment**

The selected remedy will protect human health and the environment by achieving the controls. Existing human health risks due to consumption of metals contaminated shallow ground water will be eliminated by supplying affected household with public water or point-of-use treatment units. Future risks to human health will be reduced by implementation of institutional controls that will ensure proper construction of private water wells.

There are no short-term threats associated with implementation of the remedy that cannot be readily controlled. In addition, no adverse cross-media impacts are expected from the remedy.

### **11.2 Attainment ARARs**

The selected remedy will comply with all action- and location-specific ARARs, discussed below. However, the selected remedy will not comply with the chemical-specific ARARs. Compliance with ARARs is required of the selected remedy unless a waiver of an ARAR is justified. EPA has determined that meeting the chemical-specific ARARs are technically impracticable and is issuing a waiver for this Site. See Attachment 1 for a detailed discussion on the technical impracticability of remediating the ground water.

ARARs for the selected remedy are identified and categorized as either "Applicable" or "Relevant and Appropriate" in Table 4 through 6. These tables also describe the requirements for each ARAR.

#### **11.2.1 Chemical-Specific ARARs**

None of the alternatives under consideration provide for cleanup of the shallow aquifer ground water to drinking water standards because aquifer restoration is considered technically impracticable. Thus, none of the alternatives can comply with the chemical-specific ARARs. A technical impracticability waiver of chemical-specific ARARs is necessary for the selected remedy for ground water at this site. Attachment 1 provide a detailed discussion of the technical impracticability of remediating the shallow ground water aquifer. Although the availability of alternate water supplies by a public system or by individual home water treatment systems will provide adequate drinking water to the affected residents at this Site, the availability of such alternate water supplies does not obviate the need for a waiver of chemical-specific ARARs. The chemical-specific ARARs are listed in Table 4.

#### **11.2.2 Location-Specific ARARs**

Compliance with location- and action-specific ARARs will be addressed during remedial design of selected remedy which require construction of public water systems. However, no remedial design problems resulting in noncompliance are anticipated.

The location-specific ARARs that will be attained by this remedial action are based on the location of the Site and the effect of the hazardous substances on the environment. The response actions undertaken by the selected remedy will attain the location-specific ARARs for historic preservation, archeological areas, and endangered species. These location specific ARARs are identified in Table 5.

#### **11.2.3 Action-Specific ARARs**

The action-specific ARARs are based on activities and technologies to be implemented at the site. The water distribution system construction activities undertaken by the selected remedy will attain the action-specific ARARs identified in Table 6.

### **11.3 Cost-Effectiveness**

The selected remedy is cost-effective because it will provide overall effectiveness proportional to its costs. The selected remedy will achieve the remedial action objective, and thus effectively reduce unacceptable risks to human health, at an estimated cost of \$2.7 million. The selected remedy is the most expensive remedy that is protective of human health, and is selected because it is the most protective, reliable, and permanent of the alternatives considered, and is the alternative preferred by the public.

### **11.4 Utilization of Permanent Solutions and Alternative Treatment Technology to the Maximum Extent Practicable**

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for this remedial action. The hookup of households with contaminated private water wells above health-based levels to public water supplies will permanently eliminate human health risks for these residents. The community expressed to EPA during the public comment period its concern that point-of-use treatment units were not as permanent and not as reliable as public water, and that they preferred public water over the treatment units. EPA incorporated hookups to existing public water supplies to the greatest extent to reduce the reliance on treatment units, resulting in a more permanent and reliable solution. The other actions which are part of the selected remedy, institutional controls and monitoring, are not as permanent as the engineering actions, but will still provide a high degree of long-term effectiveness.

The selected remedy provides the best balance among the alternatives evaluated with respect to the evaluation criteria. EPA relied strongly on the issue of permanence and reliability, as well as community acceptance, in selection of the remedy. The selected remedy best meets the statutory requirement to utilize permanent solutions to the maximum extent practicable.

### **11.5 Preference for Treatment as a Principal Element**

The selected remedy effectively reduces risks through a combination of engineering and institutional controls, and includes treatment technology to the maximum extent possible. Point-of-use treatment units will be installed where affected households cannot be cost effectively connected to public water supplies.

EPA assessed treatment of the ground water aquifer to remove metals contamination from the aquifer itself and determined that treatment is technically impracticable. See Attachment 1 for more information.

**Table 4**  
**Chemical-Specific ARARs and Guidance to Be Considered**

Standard, Requirement, Criteria, or Limitation	Citation	Description	ARAR or TBC
<b>FEDERAL</b>			
National Primary Drinking Water Regulations	40 CFR Part 141	Establishes health-based primary drinking water standards, MCLs and MCL Goals, for public drinking water systems	ARAR
		Cadmium MCL - 0.005 mg/l	
National Primary Drinking Water Regulations	40 CFR Part 141	Lead Action Level - 0.015 mg/l	TBC
National Secondary Drinking Water Regulations	40 CFR Part 143	Secondary drinking water standards, SMCLs, to control contaminants in drinking water that affect the aesthetic qualities relating to the public acceptance of drinking water.	TBC
		Manganese MCL - 0.05 mg/l	
		Zinc MCL - 5.0 mg/l	
Final Guidance on Numeric Removal Action Levels for Contaminated Drinking Water Sites	OSWER Directive 9360.1-02	Transmits final methodology and guidance on calculating numeric RALs at Superfund sites in deciding whether to provide alternate sources of drinking water.	TBC
		Manganese RAL - 0.20 mg/L	
		Zinc RAL - 3.0 mg/L	
<b>STATE</b>			
Missouri Safe Drinking Water Act	Missouri Revised Statutes (RSMo)640.100-140		TBC
Missouri Safe Drinking Water Regulation	10 Code of State Regulation (CSR) 60	Contains MCLs and monitoring requirements for drinking water supplies.	
		Cadmium - 0.005 mg/l	ARAF
		Zinc - 5.0 mg/l	
		Manganese - 0.05 mg/l	
Lead General Requirements	10 CSR 60-15.010	Establishes treatment requirements for corrosion control, source water treatment, and lead service line replacement. Defines lead action levels.	TBC
		Lead Action Level - 0.015 mg/l	

**Table 5**  
**Location -Specific ARARs and Guidance to Be Considered**

Standard, Requirement, Criteria, or Limitation	Citation	Description	ARAR or TBC
<b>FEDERAL</b>			
Archaeological and Historic Preservation Act	16 USC Secs. 469-469c-1 40 CFR Sec. 6.301 (c)	Establishes procedures to provide for preservation of historical and archaeological data which might be destroyed through alteration of terrain as a result of a Federally licensed activity or a program.	ARAR
Archaeological Resources Protection Act	16 USC Secs. 470aa-mm	Requires permit for any excavation or removal of archaeological resources from public or Indian lands. Provides guidance for federal land managers to protect such resources.	ARAR
National Historic Preservation Act Executive Order 11593	16 USC Sec. 470 40 CFR Sec. 6.301 (b) 36 CFR Part 800 36 FR 8921, 5/3/71	Requires Federal agencies to assess the effect of any Federally assisted undertaking or licensing on any district, site, building, structure, or object that is included in or eligible for the National Register of Historic Places.	ARAR
Historic Sites, Buildings, and Antiquities Act	16 USC Secs. 461-470 40 CFR Sec 6.301(a)	Requires Federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks to avoid undesirable impacts on such landmarks.	ARAR
Fish and Wildlife Coordination Act	16 USC Secs. 661-666b 40 CFR Sec. 6.302(g)	Requires any Federal agency or Federally permitted entity to consult with the U.S. Fish and Wildlife Service and appropriate state agency prior to modification to any stream or body of water. The intent is to conserve, improve, or prevent loss of wildlife resources.	ARAR
Fish and Wildlife Conservation Act	16 USC Secs. 2901-2912	Requires Federal agencies to utilize their statutory and administrative authority to conserve and promote conservation of non-game fish and wildlife species.	TBC
Endangered Species Act	16 USC Sees. 1531-1544 50 CFR Parts 17, 402 40 CFR Sec. 6.302(h)	Requires that Federal agencies insure that any action authorized, funded, or carried by the agency is not likely to jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify critical habitat.	ARAR

Executive Order on Floodplain Management	Executive Order No. 11988 40 CFR Sec. 6.302(b) and Appendix A	Requires Federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid, to the maximum extent possible, the adverse impacts associated with direct and indirect development of a floodplain.	TBC
Executive Order on Protection of Wetlands	Executive Order No. 11990 40 CFR Sec. 6.302(a) and Appendix A	Requires Federal agencies to avoid, to the maximum extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid new construction in wetlands if a practicable alternative exists.	TBC
Farmland Protection Policy Act EPA Policy to protect environmentally significant agricultural lands	7 USC 4201 et. seq. 40 CFR Sec. 6.302(c)	Protects significant or important agricultural lands from irreversible conversion to uses which result in its loss as an environmental or essential food production resource.	TBC
RCRA	42 USC Sec. 6901 40 CFR 264,18(b)	Requires that any hazardous waste facility located within the 100-year floodplain be designed, constructed, operated, and maintained to avoid washout.	ARAR
STATE			
Missouri Safe Drinking Water Act	RSMo 640.100-140		
Missouri Safe Drinking Water Act Regulations	10 CSR 60	Contains MCLs and monitoring requirements for drinking water supplies.	ARAR
* Siting Requirements, Recreational Use of Impoundments	10 CSR 60-10	Prohibits siting new or expanded water supply systems in areas subject to significant risk from earthquakes, flood, fires, or pollution. Contains provisions for the use of public water supply impoundments for recreation.	ARAR

Table 6  
Action-Specific ARARs and Guidance to Be Considered

Standard, Requirement, Criteria, or Limitation	Citation	Description	ARAR or TBC
FEDERAL			
Safe Drinking Water Act	42 USC Secs. 300f-300j		
* Hazardous Waste Injection Restrictions	40 CFR Part 148	Identifies hazardous wastes that are restricted from disposal into Class 1 hazardous waste injection wells.	ARAR
STATE			
Missouri Water Resource Law	RSMo 640.400-435	Establishes state surface and ground water monitoring and inventory program, which is to include determination of ambient surface and ground water quality, detection of trends in character and concentration of contaminants and pollutants, and identification of areas highly vulnerable to contamination.	ARAR
Major Water User Registration	RSMo 256.410 10 CSR 23	Requires major water users (>100,000 g.p.d.) to file a registration document with the Division of Geology and Land Survey, Department of Natural Resources	ARAR
Missouri Water Well Driller's Law	RSMo 256.600-640 10 CSR 23	Sets fees and standards to be followed in installing, maintaining, and abandoning water wells and monitoring wells. Also covers well plugging and proper isolation of possible sources of contamination from existing wells to protect the quality of ground water aquifers that provide safe drinking water.	ARAR
Missouri Public Drinking Water Program Guidelines	Missouri Dept. of Natural Resources Design Guide for Community Public Water Supplies, January 1988	Public Drinking Water Program guidelines for public water system design including recommendations for both water quality and quantity.	ARAR

Missouri Safe Drinking Water Act	RSMo 640.100-140 10 CSR 60	Contains MCLs and monitoring requirements for drinking water supplies.	ARAR
* Source Water Treatment Requirements for Lead and Copper	10 CSR 60-15.040	Provides source water treatment options for systems that exceed lead and copper action levels	TBC
* Public Education and Supplemental Monitoring Requirements	10 CSR 60-15.060	Provides format for informing the public about the health effects of lead and copper in drinking water.	TBC
* Monitoring Requirements for Lead and Copper in Source Water	10 CSR 60-15.090	Contains collection methods and sample location and size requirements for systems that exceed lead or copper action levels and systems where source treatment has begun.	TBC

## 12.0 Documentation of Significant Changes

EPA has modified the selected remedy from the Proposed Plan by reducing the number of point-of-use treatment units, hooking up threatened residences to public water supply lines, and including the cost of hook ups as part of the capital costs. This results in a significant cost increase in the selected remedy from the Proposed Plan. The overall remedial approach represented by the selected remedy remains the same as the Proposed Plan, which is to provide alternate water supplies to residents using the contaminated shallow aquifer for drinking water supplies. Thus, the changes do not fundamentally alter the remedy.

The changes are based on significant comments received from the affected community. During the public comment period, EPA received new information that several water mains are already in place and can be readily used to provide public water in certain areas. Thus, Alternative 7 is no longer a preferred alternative as stated in the Proposed Plan because it no longer provides the most appropriate balance of tradeoffs among the alternatives with respect to the nine evaluation criteria. EPA has determined that Alternative 6A (a modification of Alternative 6 in the Feasibility Study) is the best balance of tradeoffs.

Alternative 6A is the best way to provide alternative water supplies and utilize the existing public water infrastructure. The main difference between Alternative 6 (as described in the Proposed Plan) and Selected Remedy is the provision of public water supplies not only to the affected private water well users (wells with exceedances of SDWA standards), but also to the threatened private water well users. Alternative 6 provided public supplies to only 51 residences and monitored the threatened residences. The Selected Remedy provides public supplies to 340 residences. However, five homes that are too remote from water mains will be provided treatment units and monitored. In addition, Alternative 6A includes the hook up fees for the residents and Alternative 6 did not. The additional costs in the Selected Remedy from the increase in the number of hook ups and the inclusion of hook up fees is estimated to be approximately \$774,448. Another reason the cost estimate increased in the Selected Remedy compared to Alternative 6 is because of a need for an estimated 52,300 linear feet of eight inch cast iron main pipeline necessary for service connections to the Missouri American Water Company supplies. The cost for this type of water main is estimated at \$1,046,000, which is an increase of \$483,274 over the estimate for the smaller PVC mains proposed in Alternative 6. See Table D-3 in the Feasibility Study.

EPA estimates the cost of providing public water to each of the 340 residences in the area is about \$7,923 per residence. Thus, Alternative 6A is a cost-effective way to provide 340 families with safe, permanent and reliable drinking water. For comparison Alternative 6 proposed hookup of 61 household to public water at a cost of \$1,436,403, or \$23,547 per home. Alternative 7 proposed supplying alternate water supplies through PWS #3 and treatment units to 223 homes at a cost of \$1,236,857, or \$5,546 per home.

The majority of the cost increase between Alternative 6 (which was subject to notice and comment) and Alternative 6A, is the increase associated with the provision of public supplies to threatened homes. The public had an opportunity to comment on the need for the remedy to address threatened residences as opposed to only those residences with actual exceedances, e.g., see the comment from ASARCO, page 2 of the Responsiveness Summary. Thus, the changes in Alternative 6A, while significant in terms of cost estimate, were reasonably anticipated based on information available to the public in the Proposed Plan and the Feasibility Study. The changes are more fully described in Section 10 of this ROD. Further public comment is not warranted given the strong public support for public water supplies during the comment period and that the changes could have been reasonably anticipated.

**Attachment # 1**  
**Technical Impracticability Information**

**Purpose**

This attachment to the Record of Decision (ROD) for the Ground Water Operable Unit of the Oronogo/Duenweg Mining Belt Superfund Site, Jasper County, Missouri, provides justification for the U.S. Environmental Protection Agency (EPA) determination that attainment of federal and state drinking water standards in the shallow aquifer is technically impracticable (TI) from an engineering perspective. This information compliments Sections 10 and 11 of the ROD. The reader should refer back to these ROD sections for additional detail, as this attachment is intended as a supplement to the existing provided information.

This TI information is intended to provide rationale for not achieving the chemical-specific applicable or relevant and appropriate requirements (ARARs). Ground water in this shallow aquifer typically exceeds risk-based federal primary maximum contaminant level (MCL) safe drinking water standards for cadmium, and nickel; secondary drinking water standards for manganese; and lead action levels under the Safe Drinking Water Act (SDWA) (not an MCL). In particular, the risk-based standards under the SDWA for cadmium, lead, manganese, nickel, and zinc have been exceeded in the shallow aquifer. This waiver is expected to cover the entire watershed within Jasper County.

The justification for this determination of TI is based on the fact that compliance with legally ARARs would be inordinately costly from an engineering perspective.

**Background**

The Ground Water Operable Unit of the Oronogo/Duenweg Mining Belt Site is located throughout Jasper County. The Site encompasses approximately 270 square miles or nearly 40,000 acres and contains an estimated nine million cubic yards of mining wastes. The Site is a component of the much larger Tri-State Mining District which is estimated at approximately 500 square miles and covers portions of southeast Kansas, southwest Missouri, and northeast Oklahoma. The Tri-State District was mined for approximately 100 years from the mid to late 1800s to the mid 1970s. Figure 1 illustrates the location of the Oronogo/Duenweg Mining Belt Site.

Three EPA National Priority List (NPL) Superfund sites are contained within the Tri-State Mining District and consist of the following: Cherokee County, Kansas; Tar Creek, Oklahoma; and Jasper County, Missouri. A fourth Missouri site is currently in the early stage of an EPA removal program assessment (Newton County, Missouri). EPA Regions VI (Tar Creek, Oklahoma site) and VII (Kansas and Missouri sites) have coordinated on the cleanup actions completed to date. The three NPL sites are complex large area lead sites that have been subdivided into several subsites and/or operable units. Figure 1 in the ROD depicts the locations and descriptions of the Oronogo/Duenweg site and the engineering components of the selected remedy. Additionally, Tables 2 and 3 in the ROD include descriptions and comparisons of the selected remedy, including costs, and other evaluated alternatives.

**Conceptual Hydrogeologic Model**

The Oronogo/Duenweg site is underlain by two distinct hydrogeologic units that are generally not in hydraulic communication. The upper hydrogeologic unit is comprised of Mississippian age formations which host the ore bearing mineral deposits that were actively mined. The lower hydrogeologic unit consists of Roubidoux, Eminence, Potosi, and Lamotte formations consisting of sandy dolomites and lenticular sandstones which are hydraulically separated from the uppermost unit by lower Mississippian age shales and argillaceous limestones. The conceptual hydrogeologic model is depicted by Figure 1 of this Attachment. The uppermost aquifer is in communication with the following features: ore deposits; milling and mining wastes that have been placed in abandoned mine workings; exploration shafts, tunnels, and mine ventilation holes; and mined drift areas. The uppermost hydrogeologic unit is unconfined and is characterized by poor water quality due to high levels of calcium sulfate. Well yields in the shallow aquifer are highly variable and, on a site-wide basis, are predominantly dependent on secondary permeability features within the Mississippian formation. Secondary permeability results from solution enlargement along bedding planes, fractures, or solution channels, or dissolution and collapse of limestone. Limestone collapse has created brecciated areas which were later focal points of mineralization. Highly permeable breccia areas may yield up to several hundred gallons per minute (gpm) of water, whereas areas of non-brecciated, unaltered limestone generally have low yields. Secondary permeability has also been created in areas of extensive interconnected mine workings. Recharge of the shallow aquifer occurs through infiltration of precipitation on the permeable Mississippian limestones which comprise the majority of surface outcrops, particularly south and east of the Spring River. Recharge is fairly rapid as precipitation infiltrates quickly and is transmitted along

solution enlarged openings. Topographic highs constitute recharge areas at the site; specifically the southern end of the Oronogo/Duenweg Designated Area, and to a lesser extent in the area between Center Creek and Spring River. Ground water flow in the shallow aquifer generally follows surface topography. In general, shallow aquifer ground water is not transmitted across major streams including Turkey and Center Creeks, North Fork of the Spring River, and the Spring River. Zones through which no ground water flows occurs are called hydrologic boundaries. Therefore, major streams are considered hydrologic boundaries in the shallow aquifer. However, upper Turkey Creek and Grove Creek do not act as hydrologic divides. Due to the generally large relief in the area, it should be expected that only shallow flow systems should occur; that is, that shallow aquifer ground water will flow only to the next topographic low and discharge there. With few exceptions, discharge areas occur along all major streams at the site. Additionally, discharge occurs through seeps, springs, shallow aquifer wells, flowing mine openings, and collapsed features.

The lower hydrogeologic unit consists primarily of the Cambrian/Ordovician Age Roubidoux, Eminence, Potosi, and Lamotte dolomites and sandstone formations. The lower aquifer is recharged by precipitation to the formations where they outcrop in the Ozark region, well to the southeast of Jasper County. No effects of local precipitation on ground water levels in the deep aquifer have been observed. Abandoned or deteriorating wells, exploratory drill holes and shafts may also allow some leakage to the deep aquifer, although such conditions have not been confirmed in Jasper County. The U.S. Geological Survey study of the deep aquifer in northeastern Oklahoma determined that, in all instances, contamination of the deep aquifer can be explained by faulty well seals or leaky well casings that allow shallow aquifer water to enter the well bore. Flow in the deep aquifer occurs under a generally east-to-west trending regional gradient with the driving force coming from recharge via precipitation on the western flank of the Ozark Mountains. This regional flow is impacted by withdrawal of ground water by local rural water districts (RW/Ds) or other private or commercial wells resulting in local cones of depression. Other than pumped wells, the deep aquifer has no apparent discharge to the surface at the site. Deep aquifer water is of a calcium-bicarbonate type with secondary magnesium, as is typical of a dolomite aquifer. Metal levels in the deep aquifer are typically low with maximum constituent concentrations below MCLs for arsenic, cadmium, lead, manganese, nickel, and zinc. Cities or communities that derive their water supply from deep aquifer wells are: Alba, Neck City, Carl Junction, Cartersville, Duenweg, Oronogo, Purcell, and Webb City. The lower aquifer also provides water for agricultural and industrial use.

#### **Contaminant Sources**

The major contaminant sources for the shallow ground water are the result of the previous mining operations that have occurred over the approximately 100 years of mining operations. The rock in Jasper County was mined from the mid to late 1800s to the mid 1970s and in the process produced mine waste piles, pits, and lagoons. The pits and lagoons which contained surface water became contaminated with high levels of metals. Further interaction of this highly oxygenated surface water with the shallow aquifer system caused high levels of metals contamination within the shallow aquifer through dissolution of metals from mineral surfaces left in the mine voids. Additionally, residual mineral deposits left in the mine openings are now in contact with oxygenated ground water which contributes to metals leaching and further contamination of the ground water.

#### **Ground Water Use**

Ground water in Jasper County occurs in two aquifers, the shallow and the deep aquifer, which are separated throughout the region by a confining unit as shown conceptually on Figure 1. Aquifers are geologic formations that can transmit usable quantities of water, while confining units yield little or no water and tend to impede transmission of water between geologic formations. The shallow aquifer can occur in any of the Mississippian formations although little water is provided by the Fern Glen Formation. The shallow aquifer averages approximately 300 feet in thickness, ranging to a maximum thickness of approximately 400 feet. The shallow aquifer is used as a source of drinking water in portions of the site not served by municipal or rural water districts. The shallow drinking water is used as a drinking water supply in Neck/Alba, Oronogo-Duneweg, and Iron Gates Extension designated areas of the Site. There are approximately 600 residential homes served with ground water from the shallow aquifer.

The deep aquifer ranges up to 850 feet. The majority of water is supplied by the Roubidoux Formation and the Eminence and Potosi Dolomites. The deep aquifer is a confined aquifer overlain and underlain by relatively impermeable materials. The deep aquifer is a major source of drinking water for Alba, Neck City, Carl Junction, Cartersville, Duenweg, Oronogo, Purcell, and Webb City. There are approximately 10,000 residential homes served with ground water from the deep aquifer. The deep aquifer is also used for agricultural and industrial use.

## Restoration Potential

As discussed above, the Site encompasses approximately 270 square miles. Ground water flow in the shallow aquifer occurs primarily in the fractured breccia zones and secondary openings created by both the dissolution of the bedrock formations and underground mining. Water well sampling conducted during Site investigations has shown that distribution of metals contaminated in the shallow ground water is extremely sporadic. Action level exceedance of metals in individual wells is dependant on interception of fracture zones connected to contaminant sources. This condition prohibits affective cleanup by conventional ground water pump and treat systems to restore the aquifer for safe drinking water use. EPA has determined that design of a ground water recovery system and placement of pumping well to intercepted all fractures and openings conducting contaminated would be nearly impossible. The TI determination is based on the technical difficulty, as well as, the inordinate cost to attain the ARARs for the protection of human health. However, limited ground water remediation may be conducted as part of a subsequent ROD to address ecological risks created by ground water contributions to surface water.

## Inordinate Cost Determination

To meet the chemical-specific ARARs for the shallow ground water, an extensive pump and treat system would be needed at numerous locations within Jasper County to treat tile contaminated shallow ground water. The sheer size of Jasper County makes the cost prohibitively high. The cost to treat the metals-contaminated ground water is estimated to be \$2.5 per 1,000 gallons of ground water and the total cost would range from \$60 - 90 million. In addition, it is difficult to predict if the MCLs would be met with a pump and treat type of alternative because the mine wastes in Jasper County are expected to continue leaching into the shallow ground water system and deem cleanup virtually impossible.

Treating the shallow ground water would include pumping the water into large above ground storage tanks, chemical precipitation of the metals from the ground water, repumping the "cleaned water" back to the shallow aquifer, and disposal of hazardous waste sludge. This cost estimate assumes that the system would operate for 30 years and require monitoring for an additional 10 years. The major cost items would be the piping and pumps (as well as the energy requirements), chemical precipitation chemicals, hazardous waste disposal costs, and the labor associated with implementing this process.

Maior Cost Component	Cost Range (\$ million)
	4
Piping and Pumps	10-20
Energy Requirements	5-10
Chemical Precipitation Chemicals	5-10
Hazardous Waste Disposal	20-30
Labor Requirements	10-20

EPA considers the increased cost of engineering actions at the Oronogo/Duenweg Site to be inordinately costly when considering the fact that Alternative 6A, the Selected Remedy, will protect human health for all residents at the Site. Any gain would be very limited since Alternative 6A would protect the health of all residents.

The positive environmental impacts include being able to use the shallow ground water system as a drinking water source in the future and improving the water quality of receiving stream. The negative environmental impacts resulting from this pump and treat alternative include possibly lowering water levels at local streams, disrupting the ecological system, and changing naturally occurring wetlands. An additional negative impact would be the possibility of drawing down the shallow aquifer past where it could no long be used for agricultural and industrial purposes.

After consideration of all facts, in combination with the size and volume (nine million cubic yards) of mining wastes at the site, EPA considers remediation of Oronogo/Duenweg Superfund site to be technically impracticable based on inordinate costs from an engineering perspective.

## **Selected Remedy**

The selected remedy, Alternative 6A, provides for a high degree of protection for residential homes and human health; however, none of the Feasibility Study report alternatives were deemed capable of meeting chemical-specific ARARs established by the SDWA. Chemical-specific ARARs would not be met in the shallow aquifer in all areas of the site because treatment of the shallow aquifer to improve water quality is technically impracticable from an engineering perspective as discussed above. However, Alternative 6A will provide a public water supply that meets federal and state drinking water standards (chemical-specific ARARs) at the point-of-use for those households that choose to use and pay for public water. Those households that do not choose to connect to the public water system would potentially be using ground water that does not meet these standards.

Alternative 6A is also expected to comply with all potential location-specific ARARs listed in the ROD. Construction of water distribution lines is expected to occur in existing county right-of-way or easements where roads or the utilities are already located. Therefore, construction activities are not expected to impact sensitive ecological areas such as wetlands, endangered species habitat, flood plains, or wild and scenic rivers. Also, protection of known historical or archaeological sites will be ensured by designing around any identified sites.

The new water distribution systems to be installed as part of this remedy will be designed to readily comply with the ARARs identified for this alternative. Action-specific ARARs identified for Alternative 6A include the Missouri Public Drinking Water Program Guidelines and the federal and Missouri Safe Drinking Water Acts. Other potential action-specific ARARs identified in the ROD are not expected to apply to this remedy because developing new water resources or drilling new deep wells is not required. Only the construction and O&M of distribution systems is proposed.

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**Attachment #2**  
**Responsiveness Summary**  
**Ground Water, Operable Unit 04**  
**Oronogo/Duenweg Mining Belt Site**  
**Jasper County, Missouri**

**Introduction**

This Responsiveness summary has been prepared in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and the National Contingency Plan (NCP) 40 CFR § 300.430(f). This document provides the United States Environmental Protection Agency's (EPA) response to all significant comments received on the Proposed Plan from the public during the 30-day comment period.

On March 16, 1998, the EPA released the Proposed Plan and Administrative Record File containing the Remedial Investigation, Human Health Risk assessment, Feasibility Study, and other pertinent documents for public review and comment. The Proposed Plan discussed the EPA's proposed action to address ground water contaminated with lead and cadmium. The public comment period was open from March 16 to April 17, 1998. The EPA held a public meeting on March 24 at Missouri Southern State College in Joplin, Missouri, to present the Proposed Plan and discuss results of investigations and the Feasibility Study. A copy of the transcript from the public meeting is included in the Administrative Record File.

**Comments Received from the Public and Responses**

The following significant comments were received in writing during the comment period or verbally during the public meeting.

Two citizens in the Iron Gates Extension Designated Area (IGE DA) commented that several of the households in that area proposed for point-of-use treatment units were within ½ mile of public water supply lines and should hooked up to these main in lieu of treatment units.

EPA considered this comment and modified the selected alternative to include hookups to public water in the IGE DA.

The City of Joplin commented that they are pursuing annexation in a portion of the Oronogo/Duenweg Designated Area (O/D DA) and would be required to extend public water supply mains into the area, but only to within 600 feet of residences for fire protection. The City requested that EPA consider bearing the expense for hooking up the households in the area since many homeowners may not be able to afford to extend service the extra 600 feet to their home.

EPA considered this comment and modified the selected alternative to include hookups to public water in the O/D DA during the remedial action.

The Jasper County Health Department and the Jasper County Superfund Site Coalition (JCSSC) commented that several households are located within Public Water Supply Districts (PWSDs) No. 1 and No. 2 that not hooked up to those systems and are using private shallow water wells. They stated that these households should be sampled and monitored.

EPA has incorporated monitoring of households in these areas into the selected remedy. If households are found with wells exceeding action levels in the existing PWSDs they will be hooked up to the public system.

PWSD No. 3 and the JCSSC both commented that they support EPA's decision to include their district into the selected alternative.

EPA's selected remedy includes PWSD #3.

ASARCO Incorporated, one of the potentially responsible parties for the contamination at the site, made several comments that the EPA should select Alternative 4 from the Feasibility Study, which consists of point-of-use treatment units only.

ASARCO comments that private shallow aquifer water wells not currently exceeding the established water quality standards under the Safe Drinking Water Act (SDWA) are not threatened because there is no indication that such wells are getting progressively worse. ASARCO comments that any wells not now affected by heavy metal contamination are unlikely to become affected in the future. ASARCO commented that contamination from past mining disturbance would likely be diminishing through time. EPA strongly

disagrees. The selected remedy provides alternative water supplies to threatened residences in the affected areas that use the shallow aquifer because the Remedial Investigation and Feasibility Study for this Operable Unit clearly demonstrate that the shallow aquifer is affected by inactive mining and mineralization. The characterization of the nature and extent of groundwater contamination at the site clearly defines areas that are threatened with contamination are within ½ to 1/4 mile of mining and mineralization. In general, the residences that receive alternate water supplies under the selected remedy are located in such areas. In addition, even the average levels of contaminants of concern in the shallow ground water exceed the established criteria for safe drinking water under the Safe Drinking Water Act (SDWA). Moreover, Attachment #1 to this ROD, Technical Impracticability Information, strongly supports the need to protect the threatened private water well users. Attachment #1 summarizes evidence in the record that (1) the shallow ground water is contaminated with high levels of metals and (2) the shallow aquifer contamination is extremely wide spread with ground water flowing such that the distribution of heavy metal contaminants in the shallow aquifer is extremely sporadic. "Action level exceedance of metals in individual well is dependant on interception of fracture zones connected to contaminant sources," Attachment #1, page 2. In this ground water, the fracture zones (which can occur at any time due to solution of the limestone) as well as the extensive interconnected mine workings (which are constantly subject to subsidence and solution enlargement) provide the secondary permeability that result in highly variable well yields and thus, highly variable levels of contamination within the aquifer. Finally, EPA finds nothing in the records that supports any natural attenuation of the contamination in this aquifer nor is there any evidence in the record that contamination left over from mining activities will diminish over time. In the administrative record, the evidence shows that under the status quo, acid mine drainage continues and contamination spreads throughout the shallow aquifer.

The evidence in the Administrative Record for this ROD supports the decision to provide alternate water supplies to the threatened residences. In addition, the statutory requirements of CERCLA authorize EPA to provide for the remediation of the release or "substantial threat of such a release" of hazardous substances that may present an imminent and substantial danger to public health or welfare. Section 104(a)(1) of CERCLA, 42 U.S.C. § 9601 (a)(1). The evidence in the Administrative Record supports this reasonable and rationale decision to protect the threatened residences at this site.

ASARCO also comments that long term monitoring of the residences with water softeners is unnecessary and that long-term monitoring would be necessary for public water supplies. EPA disagrees that monitoring is unnecessary for the water softeners. We agree that monitoring is required for the public supplies as environmental laws require public suppliers to monitor source waters. However, with the provision of public supplies, long-term monitoring of the effectiveness of water softeners as a method to treat the contaminated shallow aquifer will no longer be required for those residences that hook up to the public supplies.

Thus, the selected remedy has reduced the proposed monitoring costs. The selected remedy continues to require monitoring of the five water softening units that will be provided because of the uncertainties associated with the installation, operation and maintenance of these units. Such monitoring is not prescribed by environmental laws, but is required based on the human health risks at this site from consuming the shallow aquifer water that is contaminated from actual or threatened releases of hazardous substances.

Several citizens questioned the institutional controls and the ability to install future shallow water supply wells.

EPA anticipates enforcement of the Missouri well drilling laws to control future well installation at the Site. However, EPA is working closely with the local communities through the Environmental Task Force of Jasper and Newton Counties to develop an environmental master plan for Jasper and Newton Counties. This plan will contain recommendations for institutional controls. EPA will support the communities in implementation of the controls.

The JCSSC made numerous comments concerning the effectiveness of the point-of-use treatment units to reduce metals concentrations in ground water supplied to households from private wells. The JCSSC made comments concerning the effectiveness of the monitoring and maintenance of the treatment units.

EPA found during the Remedial Investigation at the Site and through installation of treatment units in homes in Galena, Kansas, as part of remedial action there, that treat units are very effective at reducing metals concentrations below action levels without the problems mentioned by the JCSSC. However, EPA has selected a remedy that does not rely on treatment units except at five homes that cannot cost effectively be connected to a public water supply. The selected remedy eliminates the need for most of the treatment units and most of the monitoring of the treatment units and threatened well that JCSSC commented on.

JCSSC commented that selection of Alternative 7 would create significant health and financial inequities between those homes receiving point-of-use treatment units and those hooked up to public water.

EPA has addressed this issue by selecting Alternative 6A as the remedy for the Site. Under the selected remedy, all but five affected households will be connected to public water supplies.